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Naval Ship and Ship Systems Needs for Early 21st Century

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Welcome to the latest edition of the *WSTIAC Quarterly*. The feature article is written by Michael Bosworth, who is Deputy Chief Technology Officer at the Naval Sea Systems Command (NAVSEA). In his article, Mr. Bosworth provides an overview of the vision, strategy and approach that was taken in establishing the future naval ship science and technology needs.

NAVSEA was established in 1974 to support the Navy's fleet of ships and naval weapon systems. The command provides research, engineering, development, and sustainment support to keep the Navy's ship systems the most advanced in the world and ready to serve at any moment. NAVSEA also serves as an acquisition support organization to any Department of Defense ship or naval system.

In order to overcome the challenges that our military faces today and will face in coming years, each of the US military services have technology needs which must be addressed. However, due to financial, practical, and other limitations, not all of the needs can be achieved, and thus they must be prioritized. Also, even if the needs can eventually be met, there is a timeline that goes along with transitioning each technology into service. In order to transition technologies into service effectively and efficiently, much planning is required. For instance, the development of a specific technology can be planned in order to match up the time it will reach deployment maturity with an insertion point on an acquisition program.

This article gives a brief introduction to the approach

that NAVSEA took to establish and prioritize technology development and the timeline for insertion into naval ships. It outlines some of the constraints and definitions of the scope of technology needs. The article then goes into some detail regarding the most recent assessment of technology needs.

This may be of interest to many readers, whether familiar with the process of assessing and planning the transition of technologies to naval ships or not. Other Services and even other agencies within the Navy certainly have different technology needs, however, this article provides a unique forum for presenting the perspective of one practitioner in the NAVSEA community. The article also shows how technologies are assessed and targeted for transition into naval weapon systems.

Ultimately, the technology needs assessment is important to a wide range of organizations because it provides a vision for the supporting community especially on how to best direct their technology development efforts. When the Chief of Naval Operations establishes the vision for the future of the US Naval weapon systems, it provides research labs, industry and the Navy with a clearer understanding of the technology needed. If all these components work together to meet the common objectives and work toward this common vision, the US Navy will remain the strongest and most technologically advanced sea force in the world.

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Naval Ship and Ship Systems Needs for Early 21st Century

Michael L. Bosworth
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The business of researching and developing technologies and integrating them into naval ships and ship systems is a complex and wide-ranging process, and multiple viewpoints are needed to represent all of the important insights. This article expresses the viewpoint of one practitioner from the Naval Sea Systems Command (NAVSEA) headquarters, who concentrates on advanced development R&D (6.4) with a focus on transition of technologies to ships.

INTRODUCTION

The Advanced Development level of R&D (research and development) is set up to help transition maturing technologies into the Program Executive Offices (PEOs) and their acquisition programs that design and build ships. Advanced Development R&D projects draw from the Science and Technology (S&T) program, which is financed for the Navy Department primarily by the Office of Naval Research (ONR), though DARPA also contributes significant S&T work to the Navy, Marine Corps, and the other services. Commercial and foreign developments also contribute other S&T level R&D.

As part of the overall S&T planning process in 2006, the Chief of Naval Research (CNR) requested that the System Commands submit their S&T needs along with those of their respective affiliated PEOs, which would be combined with ONR's own strategic planning effort in developing their overall S&T program. In this context, "S&T needs" stem from operational or engineering capabilities or affordability goals that are not being met. This article focuses on the 2006 NAVSEA S&T Needs analysis, which was conducted in response to the request by the CNR, by NAVSEA's Future Ships & Force Concepts Division, serving as a surrogate for the about-to-form Technology Office.

Figure 1 depicts the relationship between the principal parties responsible for establishing the Navy's S&T program. The figure is a simplistic view of the relationship, but illustrates how the major organizations are connected. The analysis included in this article

focuses on the red "needs" arrow, which is only one piece of the total input used by the CNR when putting together the ONR S&T Program. The other System Commands and their affiliated PEOs, which have a similar set of relationships, provide their needs as well. The Chief of Naval Operations' (CNO) Maritime Strategy and Vision for the future Navy and requirements derived from current ship programs are also considered when defining the future needs.

The intent of the analysis overviewed in this article was to take the very high level strategy and vision of the CNO and produce a consolidated Vision and Needs Report at the next lower level based on the needs from each of NAVSEA's affiliated PEOs. An outgrowth of the 2006 effort was the recognition that NAVSEA required a focal point for technology to help coordinate the various technology efforts and to serve as a facilitating interface with the rest of the S&T community including ONR and DARPA. Recently, a Chief Technology Officer (CTO), Deputy CTO, and a supporting organization was outlined. They are in the process of being established.

APPROACH

In order to establish a framework and context, PEOs also included a vision statement and broad guidance. The foundation for the analysis was based on the S&T needs provided by each of the NAVSEA affiliated PEOs. These vision statements in themselves were as important as the needs, especially in attempting to understand where a particular platform or warfare area was focused for the next generation of ships and systems. Based on these inputs, an analysis of those needs that are common to multiple PEOs and use the same technology was conducted. Although the specific PEO inputs are not described here, an analysis of those common needs is provided.

Defining the Scope and Establishing the Time Constraints

In the first step of this task the constraints and scope of the effort were defined. In the past, the scope included all future technology needs for ships and ship systems. However, this resulted in a list of every possible technology need and it provided little real guidance to the CNR. Almost anything that the S&T community might wish to pursue was included on the list. Therefore, to limit the scope of the effort, two key decisions were made. First, it was concluded that

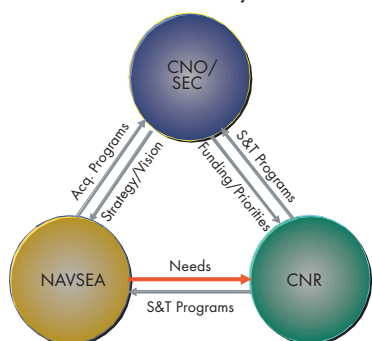


Figure 1. Relationship among NAVSEA, CNR and CNO / Secretariat (SEC)



Figure 2. 30-Year Shipbuilding Plan

the near term needs (within the first six years) should not be included because the current Future Naval Capabilities (FNC) process adequately addresses that area. Secondly, it was decided that each PEO should submit their top 10 S&T mid-term and far-term needs, although the top ten lists would not be prioritized.

Defining Time Periods for Technology Needs

For this analysis, three time periods were defined to organize the needs and correspond to the timeframes in the new shipbuilding plan. These periods were based on the 2008 Program Objective Memorandum Future Years Defense Program (POM08 FYDP) and will be adjusted as needed in the future:

- **Near-Term** – Fiscal Years 2008 through 2013

- **Mid-Term** – Fiscal Years 2014 through 2020

- **Far-Term** – Fiscal Years 2021 through 2036

Because of the ship focus of the Command and the new initiative by the CNO to stabilize a 30-Year Shipbuilding Plan, the FY06 published version of the Plan became the starting point. This set the stage for the timelines (near-term, mid-term and far-term) and which new ship platforms or modernizations provided opportunities for technology introduction. Figure 2 shows the 30-Year Shipbuilding Plan used for assessing technology needs, which has only been slightly changed for the 2008 Budget submission. In addition to laying out the fiscal year for the first production ship, the graph also shows the design space in front of that year, including the start of concept design, which is the period of focus for this assessment.

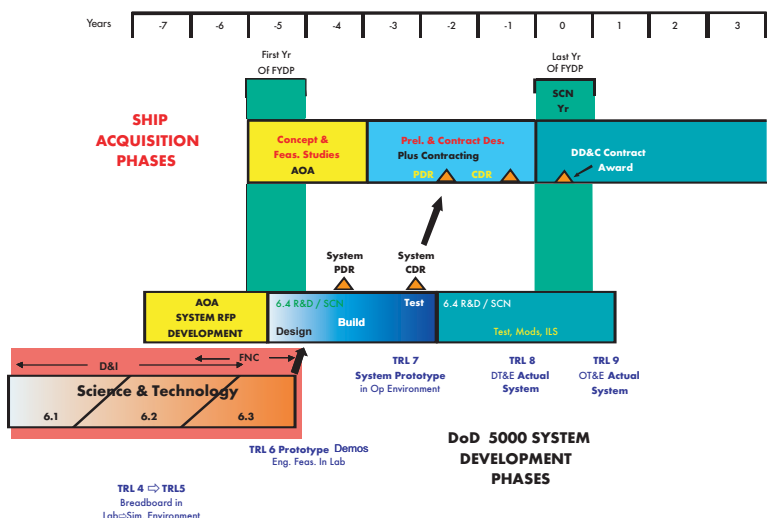


Figure 3. Ship Development and Acquisition Process

Other Time Constraints

Another key constraint on the S&T process is the time it takes to develop a new system or technology from 6.2 RDT&E (research, development, test, and evaluation) through the ONR Future Naval Capabilities process and 6.4 RDT&E. By following this process it would take about six years to achieve Technology Readiness Level (TRL) 7. Recognizing this as an approximation and a general rule of thumb for strategic planning, the Navy's Mid-Term 30-Year Shipbuilding Plan and an estimate of the expected timing for the Mid-Term Modernization programs were analyzed to determine probable start times for S&T. Figure 3 shows the R&D timeline for the subsystem development and then the acquisition phases from subsystem to the ship. The key here is that the subsystem must achieve TRL 7 to support the preliminary design review (PDR) of the ship. But FNCs may only support the subsystems up through TRL 6. Hence, there must be several years of development after completing the FNC to enable validation of the subsystem through TRL 7. It is this stack up that is the root for

the six year lead time. In fact, 7 or 8 years out is not too early to be investing in 6.2 R&D.

One of the key intentions of this ongoing S&T needs analysis is to better align the opportunities for technology insertion into systems based on the shipbuilding and modernization plans for ships and weapon systems. By combining the ship building plan from Figure 2 and a projected modernization plan with the timeline from Figure 3, the result is the diagram in Figure 4, which shows the mid-term S&T opportunities.

Future Plans

In 2007 NAVSEA is expanding and deepening the analysis in a second iteration. NAVSEA is responsible for “Ship Systems” and, therefore, the analysis uses the Navy’s formal shipbuilding plan and the current estimate of when modernizations will occur as the basis for the S&T Needs. In addition, it establishes a foundation for Advanced Development planning to facilitate the important transition to new systems.

In the same way, there are also opportunities to insert new technology during “modernizations,” which include scheduled major upgrades and, in the case of aircraft carriers, refueling and complex overhauls. Opportunities for insertion of new technology via entirely new systems, sub-systems and/or components will be driven by their affordability and by the threats facing US interests.

The increased emphasis on modularity and physically open system interfaces (analogous to the more developed electronics and computer open architecture) will provide, in the future, more opportunities for technology insertion, when less than major overhauls are executed during routine annual maintenance.

This analysis is about *prioritizing* mid-term and long-term needs. In future years, a more rigorous prioritization approach will likely be used for application to the database of needs, and the database will grow and be digitally maintained and updated for ease of review and prioritization. Having the needs in a database format provides the opportunity to look at the data from a different perspective that brings additional illumination to the process of building the ONR S&T program.

RESULTS OF THE S&T NEEDS ASSESSMENT

The S&T Needs input from the PEOs was evaluated and presented to show S&T needs that are common among multiple platforms and which use the same technology. Other areas of analysis of PEO needs by category (e.g., manning, materials, open systems) were also presented. These will enable NAVSEA to allocate the limited, but important, resources to areas best able to make a difference in Naval capabilities.

The following are key areas of common needs across multiple warfare and acquisition arenas:

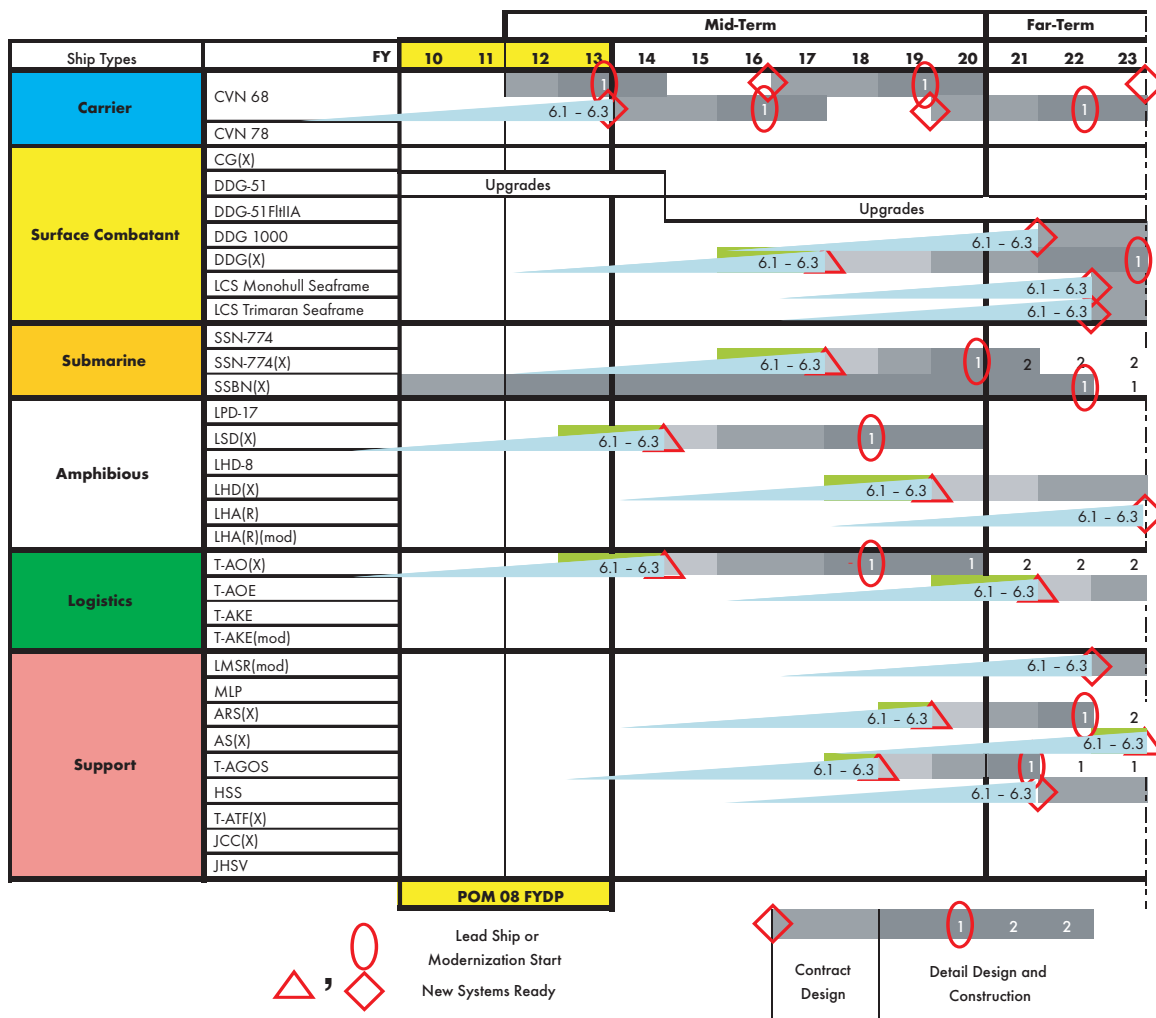


Figure 4. Mid-Term S&T Opportunities by Ship Class

- **Common Affordability Needs** that address all areas of affordability, from reduced maintenance cost to reduced acquisition cost.
- **Common Technology Needs** that address Human Systems Integration (HSI); Ship Survivability; Other Hull, Mechanical, Electrical and Logistics (HME&L); and Integrated Warfare Systems (IWS)/Littoral and Mine Warfare (LMW).
- **Integrated Weapon System Strategies** that transition from a platform to enterprise solution and then across the platforms to support the affordable Fleet.

The S&T needs assessment recommends that some 6.1 and the “core” 6.2 RDT&E devoted to ships and associated weapon systems should focus on specific new ship classes and modernizations in the mid-term and far-term so that the technology will be ready to demonstrate engineering feasibility in a timely manner.

Needs Analysis

The PEO S&T needs data (not provided in this article) was able to be cross-cut and presented to show needs that are common among multiple platforms or systems. There are many needs that are not specific to ship types. However, some may be appropriate to several, but not all, PEOs. These include:

- Common systems needs
- New materials
- New manufacturing processes
- New design techniques or analytical tools

The common needs among the various PEOs are described in more detail below.

Common Affordability Needs

The focus on affordability stems from the current budget pressures and the ability to afford the CNO’s shipbuilding plan (strategy/vision) as shown in Figure 1 (this is a FY06 plan but is updated annually). This does not mean that it is just a reduction in ship acquisition cost, but a reduction in all cost categories, since all impact the Navy’s overall budget.

In many cases, the first effort that is required is a good analysis of what can be accomplished in cost reduction through technology investment. Given the limited funds, NAVSEA must invest where there is a good chance for a return. All of the elements of cost are related to some degree. For example, simply making ships less expensive can impact the life-cycle cost (LCC). Greatly improving the reliability of systems design to reduce maintenance will impact acquisition cost, and so on. A systems approach, along with the analytical tools, should be part of any affordability initiatives. Reducing the cost of a system without the analysis to support the reduction does not result in the cost reduction being reflected in the future budget.

Common Technology Needs

HSI Needs

Clearly, Human Systems Integration is common to all systems and ship types and should continue to be a focus for future S&T. The understanding of how the watch stander or maintainer will interface with the system should expand and remain current with

the progression of new systems, levels of automation, and manning level goals. This area is also tied to the new CNO’s strategies and concept of operations.

Survivability Needs

Survivability covers a large area of technology as it represents three very different areas: susceptibility, vulnerability and recoverability. Since these areas are unique to Navy ships, there is no commercial counterpart for technology investment; a fact which requires the S&T investment in survivability to be solely the Navy’s. There are significant differences in survivability requirements between the ship types, but also many common needs among the PEOs. These are discussed by survivability area:

Susceptibility covers the control of ship signatures including: radio frequency (RF), infrared (IR), acoustic, magnetic and visual. The control is closely tied to the characteristics and capabilities of the threat sensors or weapons, and not all are of interest to each platform. It is key that the signature analysis efforts continue to evaluate what technologies are required for signature control as the threat evolves in the future. This is an area that is common to and must be

consistent with both weapon systems and platform designs, and thus the effectiveness of defensive weapons is also very important. Also, how the Global War on Terrorism (GWOT) and new CNO strategy impact this area should be included in the ongoing analysis. For example, the GWOT changes the threat weapons and battlespace and, therefore, could impact the relative importance of the infrared and visual signature control.

Vulnerability is primarily the ability of the platform or system to withstand weapons effects. The most common requirements in the ship design include protection against nuclear, biological, and chemical weapons (NBC), as well as shock and fragmentation. Since the impact of vulnerability characteristics run counter to smaller, less expensive ships, there is continuing pressure to reduce the requirements on these systems. No area is closer to the core capability of a naval ship than its vulnerability features. The fields of weapons effects, ship vulnerability

analysis, and new forms of ballistic protection need to be continued. The vulnerability to common weapons encountered in the GWOT should be the first priority.

Recoverability is the ability of a ship or system to recover its capability following an attack. This includes the classic damage control response by the ship, but should also include automation, pre-configuration of systems, and other techniques required by the reduced manning initiatives.

Other Hull, Mechanical, Electrical, and Logistics Needs

The following are common HME&L needs that are common to the various ship platforms:

- S&T that supports evolution of the current new architectures in open systems and modular, zonal and Total Ship Computing Environment (TSCE) approaches to ship and weapons system design.



Aluminum False Deck Grid and Foundation

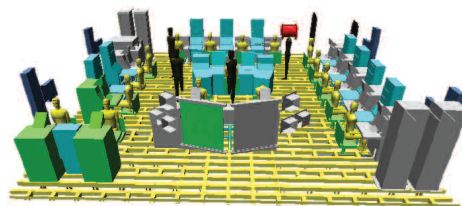
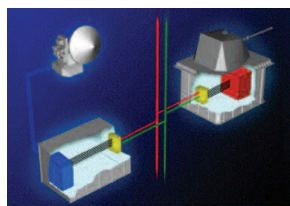


Figure 5. Examples of R&D Projects

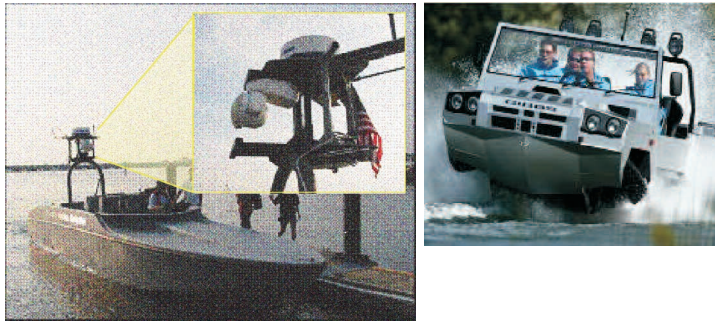


Figure 6. Examples of R&D Projects

- S&T that supports networked systems.
- S&T that supports the new high power electronics and electrical power actuators.
- The introduction of autonomous unmanned vehicles provides both technology challenges and opportunities. The operation of unmanned vehicles, including unmanned underwater vehicles (UUVs), unmanned surface vehicles (USVs), and unmanned aerial vehicles (UAVs), will expand in the future and be operated off of most naval platforms.

Other Integrated Weapon Systems / Littoral and Mine Warfare Needs

The following are common integrated weapon systems / littoral and mine warfare S&T needs that cut across the various system areas:

- Command and control for simultaneous operation of multiple unmanned vehicles.
- Increased computing power and advanced operating systems.
- Operations in littoral environment and new GWOT threats.

INTEGRATED WEAPON SYSTEM STRATEGIES

The IWS future strategy is to produce integrated systems to support multiple classes of ships. This strategy is closely linked to their investment and affordability initiatives. Figure 7 is taken from the Command's affordability study and is an example of how this strategy is applied to several systems.

SUMMARY

This article provided a high level overview of S&T needs and transition timing from the viewpoint of a single practitioner within the Naval Sea Systems Command, concentrating in Advanced Development R&D (6.4) for ships. It has long been acknowledged that later stage R&D must be timed to ship insertion opportunities, typically with use of the Ship Construction, Navy (SCN) plan for the five or six coming years. This overview suggests a means by which the S&T community and its various R&D and transition partners can accomplish this for early R&D (later S&T) by similarly utilizing the 30-Year Shipbuilding Plan as a foundation for high level R&D strategic planning, prioritization, and resourcing.

For 2007, the approach to assessing S&T needs will be expanded to incorporate a database in order to analyze the data from multiple interests and allow alignment to technical areas and organizations. Also, there will be more culling of the needs along with a strategy for prioritization. Regardless, like the Shipbuilding Plan, NAVSEA would like to have stability in the technology planning in order to provide consistency in year-to-year guidance.

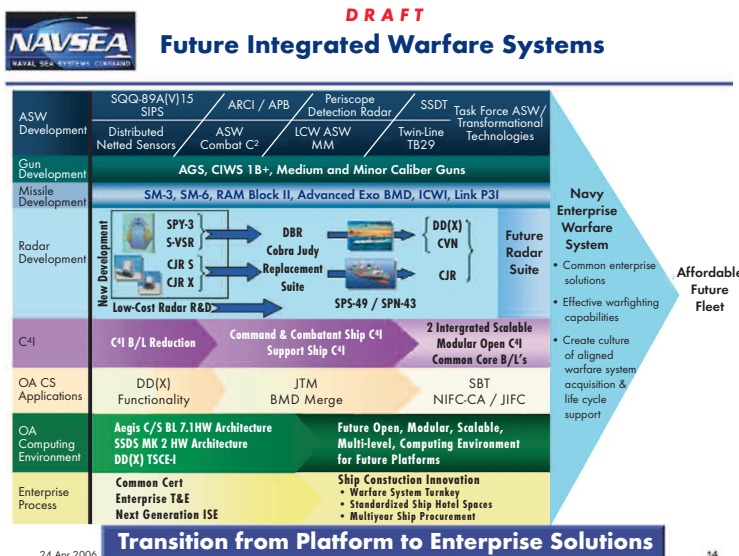


Figure 7. Future IWS Integration Strategy

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FIELD ARTILLERY FIRES NEW MODULAR ARTILLERY CHARGE SYSTEM ON TAJI

by Staff Sgt. Jon Cupp
US Army Public Affairs

CAMP TAJI, Iraq – While many artillerymen get the opportunity to fire artillery pieces only in training, Soldiers from the 82nd Field Artillery Regiment's Alpha Battery, 1st Battalion, have already fired more than 1,100 rounds in real-world missions to engage enemy targets in support of combat operations in theater.



Spc. Eduardo Briseno, a cannoneer who loads and fires howitzers for the 82nd Field Artillery Regiment's Alpha Battery, 1st Battalion, prepares to load a charge into the barrel of a howitzer on an M109A6 Paladin, March 13 on Camp Taji, Iraq, during the first-ever calibration firing of the Modular Artillery Charge System in the combat zone by an entire Paladin battery. Photo by Staff Sgt. Jon Cupp

Since the first calibration of the M109A6 Paladin howitzers in early December, Alpha Battery has supported combat operations every day by firing their Paladins. The unit has supported operations with everything from counter-fire to suppressive fire, as well as striking pre-planned targets. They have also cleared routes for combat missions along and provided base camp security. Yet one of the Soldiers' most

memorable moments came March 13 as they fired the new Modular Artillery Charge System. "We're on the brink of history," said Capt. Derek Baird, Alpha Battery commander. Baird said the event marked the first time the MACS have been fired in the combat zone by an entire battery of Paladins.

The MACS system, used in conjunction with a projectile, is a refined propellant that facilitates higher rates of fire and extends range capabilities for the howitzers, Baird explained. The pre-measured charges, which are packaged in cylindrical,

toilet-paper roll-shaped canisters, push or propel projectiles from the barrels of the howitzer. The charges also help to lessen the work of the old way of measuring charges, whereby bag charges were cut and then unused portions had to be disposed of – wasting powder, added Baird. Alpha Battery will use the MACS in conjunction with a new munition they will receive training on and implement within the next few months – the Excalibur. "This is all very exciting. Our firing of the MACS is in preparation to get Excalibur," said Baird. "This is the final step before it's fielded to us,



March 19, 2007 Soldiers from the 82nd Field Artillery Regiment's Alpha Battery, 1st Battalion, fired howitzers on their M109A6 Paladins during the first-ever firing of the Modular Artillery Charge System in the combat zone by an entire Paladin battery March 13 on Camp Taji, Iraq. The newly refined propellant pushes projectiles out of the barrel of the howitzers. The MACS will be used in conjunction with the soon-to-be-fielded Excalibur precision munition. Photo by Staff Sgt. Jon Cupp

and all of our crews have qualified on it."

Baird said his Soldiers have been fortunate to work with the howitzers, as changes in the field artillery branch have led to fewer opportunities to employ howitzers. "Now they're working more in roles that concentrate on doing foot patrols, pulling tower guard and doing cordon and searches," said Baird. "One of the most important things for my Soldiers is the fact that they're actually getting to do artillery tasks, and for them this is great and I could not be more proud of their performance today," Baird added. "We're the only true 'hot gun' battery in theater – others may have only one gun firing at any given time in support of real world missions. We're using our entire battery all the time."

First Lt. Sidney Wilson, an Alpha Battery platoon leader, said he was impressed with the MACS and hopes his Soldiers will remember the experience. "They should take pride in being the first battery to fire these in theater," said Wilson. "When they go home, this is something they can tell their families about."

Spc. Eduardo Briseno, a cannoneer who loads and fires howitzers, had his own take on what the day's firing meant to him. "I love it, I can't really explain it. There's nothing else that compares with this and nothing else I'd rather be doing," said Briseno. "Knowing that we've made history today in firing the MACS ... this really feels awesome."

A-10 MODIFICATIONS SPEED UP TO SUPPORT WARFIGHTERS

by Bill Orndorff
309th Maintenance Wing

HILL AIR FORCE BASE, Utah – The Air Force will soon benefit from an A-10 Thunderbolt II milestone achieved here in March. Personnel from the 571st Aircraft Maintenance Squadron completed a precision engagement modification on an A-10 14 days ahead of schedule. The modification gives the A-10 precision weapons capability through significant rewiring and the addition of modern avionics upgrades. The A-10C precision engagement program was accelerated by 18 months to meet the needs of the warfighter, causing the program to undergo concurrent fielding and development.

"We're delivering airplanes to Air Combat Command, Air National Guard and Air Force Reserve units, while we're still finishing the development and design of the modification," said Greg Hoffman, the 571st AMXS director. "The program is being pushed on a fast track. You start to do the modifications as you go and you don't have time to sit there and flow out how to best lay it out, so you get a couple of airplanes under your belt and then make changes as you go. It's part of continuous process improvement – we're always looking for ways to do things better."

As with many new and accelerated programs, there were challenges with parts supportability from vendors as well as maintenance procedures. "Lockheed Martin Systems Integration from Owego, NY, is the prime contractor," Mr. Hoffman said. "When you accelerate a program on us and accelerate our

aircraft flow, it accelerates the delivery schedule as well. Initially, we had some points where we were waiting for components from Lockheed, but they've done a tremendous job rising to meet every challenge and give us the support we need," he said.

To add to the challenges, the A-10s lost six production docks to another workload. Additionally, nearly 100 new technicians hired over the past year needed training. "Our squadron almost doubled in size with the addition of this modification," said Mr. Hoffman. "We had a lot of new people who had never worked in the aircraft business before, so the training curve was pretty steep. A lot of them still have less than a year at the center and they're still learning the weapon system."

As a way to ensure the program's success, a 12-member lean team was formed in October to establish a standard work package that logically flows every step of this new program from wheels down to wheels up. The team used critical chain process management, also known as buffer management, to create a daily "hot list" of operations that need to be accomplished. The team further enhanced the process by breaking the technicians into cells to improve training, quality and cost. "The cells we established were to focus on a couple issues," Mr. Hoffman said. "One was to keep our process moving. More importantly, it was to ensure our training curve was accelerated. Instead of technicians getting assigned to an airplane and having to work the entire airplane, they can focus on the gun bay area or the cockpit area so the skills build up much quicker. We keep them in that area, and when everybody gets to a certain level, then we can start swapping personnel around to expand their abilities."

These efforts will allow the 571st AMXS to meet its goal of 70 A-10 Precision Engagement modifications this year. "The 571st mechanics are well on their way to successfully executing the A-



Photo Courtesy of DoD; Photo by SRA Jacqueline Hawkins

10 Precision Engagement program," Mr. Hoffman said. "They have reduced overtime from more than 1,400 hours per aircraft to an average of 600 hours. Overall modification time was reduced from a high of 5,400 hours to

consistently less than 4,000 hours and is well on its way to the 3,512-hour target. Focusing on these aspects will not only ensure the warfighter gets a quality product on time, but reducing overtime and installation hours will, in essence, be giving money back to our customer to keep pushing additional aircraft to us within the program."

OFFICE OF NAVAL RESEARCH LAUNCHES SCIENCE AND TECHNOLOGY STRATEGIC PLAN

ARLINGTON, Virginia – Chief of Naval Research Rear Admiral William E. Landay III has unveiled a new Naval science and technology strategic plan that outlines in detail how the Department of the Navy will enable the Navy and Marine Corps of the future – and shape how Sailors and Marines will fight years and even decades down the road.

The Office of Naval Research (ONR) is the science and technology provider for the Department of the Navy. From GPS to

unmanned aerial and undersea vehicles to language translators to countless other advances in use on the battlefield and in everyday life, ONR has been cultivating basic science and providing advanced technology to the sea services and the nation since 1946.

The Naval Science and Technology Corporate Board – composed of the Assistant Secretary of the Navy for Research, Development and Acquisition; the Vice Chief of Naval Operations; and the Assistant Commandant of the Marine Corps – directed the Chief of Naval Research and ONR to develop a Naval science and technology strategy. This strategy will ensure that the investments of ONR and the Naval research enterprise support future innovative operational concepts as well as fulfill the needs of today's warfighters.

The science and technology strategic plan has three principal goals: to ensure alignment of Naval science and technology with Naval missions and future capability needs; to balance and manage the science and technology portfolio; and to communicate the science and technology vision to decision makers, stakeholders, partners, and customers.

The strategy is divided into thirteen focus areas:

- Power & Energy
- Distributed Operations
- Operational Environments
- Naval Warrior Performance & Protection
- Maritime Domain Awareness
- Survivability & Self-Defense
- Asymmetric & Irregular Warfare
- Platform Mobility
- Information, Analysis and Communication
- Fleet/Force Sustainment
- Power Projection
- Affordability, Maintainability and Reliability
- Assure Access and Hold at Risk

Investments in these focus areas will result in a Navy and Marine Corps that will have:

- Domination of the electromagnetic spectrum and cyber space
- Implemented directed energy—fighting at the speed of light
- Achieved persistent, distributed surveillance in all domains
- Achieved comprehensive maritime domain awareness with large vessel stopping and weapon of mass destruction detection for enhanced maritime intercept operations
- Incorporated affordability into platform design and construction
- Adaptive wireless communications networks
- Decision tools to give commanders tactical advantage
- Determination of threat intent through social and cultural understanding
- Lighter, faster, more lethal Marine forces
- Accelerated team training and skill development
- Increased operational effectiveness through more efficient power and fuels
- Responsive and visible logistics to enable distributed forces
- Greater tactical advantage through superior knowledge and use of operational environments

Contact: Colin Babb, Office of Naval Research, Phone: 703-696-4036, Colin_Babb@onr.navy.mil

WSTIAC Training Courses:

DIRECTED ENERGY WEAPONS (DEW) COURSE

Instructor: Dr. Edward P. Scannell, Alion Science and Technology

Location: Huntsville, Alabama
2007 Course Offering: 30-31 Oct

COURSE DESCRIPTION:

This 2 day short course provides an introduction to the basic principles and techniques of Directed Energy Weapons (DEWs). Weapon system applications will also be thoroughly analyzed. The technologies behind each type of DEW will be examined, and the critical path components will be identified and explored with respect to their effect on future DEW development. In addition, advantages that can be achieved by employing DEWs will be discussed, as well as the status of DEW developments and deployments in the international arena. The key DEW programs in High Energy Lasers and RF-DEWs or High Power Microwaves will be fully described.

This short course is provided by the Weapon System Technology Information Analysis Center (WSTIAC). It will be of great benefit to people who need to understand the basic concepts, technologies, design requirements and practical applications of DEWs, including program and business managers, political decision makers, engineers, scientific researchers and military personnel. An undergraduate technical degree is recommended. Mathematics is kept to a minimum, but important formulas are introduced.

These and many other critical questions will be examined:

- What is Directed Energy and what are the different types of Directed Energy Weapons?
- What are the advantages and disadvantages of each type of DEW and what are their target effects and tactical and strategic capabilities?
- How do DEWs work and what are the critical technologies that must be developed for their eventual use in practical systems?
- How may threat DEW effects be countered and how can we protect our own systems?
- What are the major US and international DEW programs that are being pursued?
- What is the prognosis for future DEW development?

ABOUT THE INSTRUCTOR:

Dr. Edward Scannell is a senior member of Alion's technical staff and also serves as WSTIAC's Chief Scientist. Dr. Scannell was Chief of the Directed Energy and Power Generation Division of the US Army Research Laboratory. He has over 30 years of experience in technical areas related to DEWs, including: plasma physics, conventional and alternative energy sources, electromagnetic (EM) guns, particle beam, laser, high power microwave (HPM), and pulse power physics.

SECURITY CLASSIFICATION:

The course is UNCLASSIFIED, but is designated For Official Use Only (FOUO), Export Controlled and attendance is limited to US citizens only.

FEE:

The registration fee for this two day course is \$950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can also be used.

HANDOUT MATERIAL:

Each student will receive a comprehensive set of course notes covering the material presented.

TRAINING LOCATION:

The course is taught at 6767 Old Madison Pike, Suite 95, Huntsville, AL 35806. WSTIAC can also conduct a dedicated course at your location to reduce your travel time and cost.

**For additional information,
contact Mary Priore at 315.339.7135
or mpriore@alionscience.com**

Notice: WSTIAC reserves the right to cancel and/or change the course schedule and/or instructor for any reason. In the event of a schedule change or cancellation, registered participants will be individually informed.

INTRODUCTION TO SENSORS AND SEEKERS COURSE

Instructor: Paul Kisatsky, Alion Science and Technology

Location: Huntsville, Alabama
Call for upcoming course dates

COURSE DESCRIPTION:

This 3 day course provides an introduction to the most commonly used sensors and seekers employed in smart munitions and weapons (projectiles, missiles and wide area mines). It is oriented to managers, engineers, and scientists who are engaged in smart weapons program development and who desire to obtain a deeper understanding of the sensors they must deal with, but who do not need to personally design or analyze them in depth. An undergraduate technical degree is recommended. Mathematics is kept to a minimum, but important formulas are introduced. This course also provides an excellent foundation for those scientists and engineers who desire to pursue this discipline to intermediate and advanced levels.

The course covers:

- Classification of seekers and sensors
- Fundamentals of waves and propagation
- Fundamentals of noise and clutter
- Fundamentals of search footprints
- Introduction to infrared
- Introduction to radar
- Introduction to ladar
- Introduction to visionics
- Introduction to acoustics
- Future projections and interactive brainstorming

Noise and clutter, the predominant obstacles to success in autonomous seekers, are given emphasis. The major sensor types are classified and each is discussed. In particular, infrared, radar, optical laser radar (ladar), imaging and non-imaging, and acoustic sensors are individually covered. Of special interest is the discussion on human visionics versus machine recognition, since this concept is of central importance to understanding autonomous versus man-in-the-loop sensing systems. The implications of "artificial intelligence", "data fusion", and "multi-mode" sensors are also briefly discussed. System constraints, which force trade-offs in sensor design and

in ultimate performance, are also covered. Time permitting, a projection of future trends in the role of sensors for smart munitions will be presented, followed by a "brain-storming" session to solicit student views.

ABOUT THE INSTRUCTOR:

Paul Kisatsky is a Senior Advisory Scientist with Alion Science and Technology. He is a nationally recognized Subject Matter Expert on sensors and seekers for smart munitions and weapons, and he has more than 40 years of experience in sensors and seekers analysis of modern smart weapons.

SECURITY CLASSIFICATION:

This course is UNCLASSIFIED, but is designated Export Controlled and attendance is limited to US citizens only.

FEE:

The registration fee for this 3 day course is \$950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can be used.

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SMART/PRECISION WEAPONS COURSE

*Instructors: Mr. Hunter Chockley and Mr. Bob Fitzgibbon
Alion Science and Technology*

Location: Huntsville, Alabama

2007 Course Offering: 13-15 Nov

(Course starts at 0800 Tuesday and ends at noon on Thursday)

COURSE DESCRIPTION:

This 2 1/2 day short course provides a general understanding of smart weapons and related technologies. This course is aimed at providing general knowledge about smart weapons technology and a source of current information on selected US and foreign smart weapons, to include system description, concept of employment, performance characteristics, effectiveness and program status.

A variety of ground, sea and air smart/precision weapon systems are discussed, to include fielded and/or developmental US systems such as Joint Direct Attack Munition (JDAM), Joint Standoff Weapon (JSOW), Joint Air-to-Surface Standoff Missile (JASSM), Advanced Medium Range Air To Air Missile (AMRAAM), Javelin, Excalibur, Precision Guided Mortar Munition (PGMM), High Speed Anti-Radiation Missile (HARM), Tomahawk, Standoff Land Attack Missile - Expanded Response (SLAM-ER), Small Diameter Bomb (SDB), Cluster Bomb Munitions and Non Line of Sight - Launch Systems, among others, as well as representative foreign smart/precision weapons.

The objective of this course is to inform materiel and combat developers, systems analysts, scientists, engineers, managers and business developers about smart/precision weapons, to include:

- State of the art of representative US and foreign smart weapons systems;
- Employment concepts;
- Smart weapons related systems, subsystems, and technologies; and
- Technology trends.

ABOUT THE INSTRUCTORS:

Mr. Hunter Chockley is a Science Advisor with Alion. He has more than 35 years of experience with weapons technology and/or smart/precision weapons. He has conducted advanced concept studies, and weapon system/subsystem assessments.

Mr. Bob Fitzgibbon is a Science Advisor with Alion and he has 27 years in system analysis and design. He has actively worked ECM, RF and RWR programs as well as hardware modernization efforts.

SECURITY CLASSIFICATION:

The course is UNCLASSIFIED, but is designated For Official Use Only (FOUO), Export Controlled and attendance is limited to US citizens only.

FEE:

The registration fee for this 2 1/2 day course is \$950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can be used.

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WSTIAC Success Story: THAAD

The Terminal High Altitude Area Defense (THAAD) system constitutes the upper tier of a two-tiered defense against tactical ballistic missiles of all types and ranges while in all phases of flight, and provides broad area coverage against threats to military forces and critical assets, such as population centers and industrial resources. THAAD consists of four segments: missile round; launcher; Battle Management/Command, Control, Communications, and Intelligence (BM/C3I); and radar. This weapon system is designed to perform its mission in centralized, decentralized, or autonomous modes. THAAD is deployable to theaters of operation using strategic military air, ground and ship transport.

On January 3, 2007, Lockheed Martin was awarded a contract from the Missile Defense Agency (MDA) to begin production. The contract for the first two THAAD fire units includes 48 interceptors, six launchers and two fire control and communications units. The system is scheduled for fielding in Fiscal Year 2009.

WSTIAC has actively supported the THAAD program since 1999, through a series of technical area tasks (TATs) with the Army Air Defense Artillery School. WSTIAC provided technical and analytical expertise for the Director of Combat Developments. Specific support areas are in working requirements for THAAD communications and THAAD force structure. This work has and will directly impact the effectiveness of an integrated fire control net and the organizational structure in terms of personnel and equipment. (Photos courtesy of the Missile Defense Agency)

To learn more, contact wstiac@alionscience.com



GENERIC Smart Indirect fire Simulation v2.4

Initially sponsored by the Smart Weapons Management Office (now referred to as Weapons & Technology Management Office) of US Army Materiel Command and the US Army Materiel Systems Analysis Activity (AMSAA), **GENESIS** version 2.4 is the latest in a series of **GENESIS** software products provided to the defense community through WSTIAC.

GENESIS is a many-on-many indirect fire, smart munition systems effectiveness model used to evaluate various smart weapons in the context of a generic simulation.

GENESIS was designed to model many different smart munitions within one model.

GENESIS is an end-game model—it simulates those processes that occur after dispense from the delivery vehicle.

Once the target is encountered, the simulation checks for clear line of sight, target engagement, detection, hit and kill.

GENESIS is generic from the standpoint that it can model many different kinds of weapons. Sensors are represented through multi-parameter probability lookup tables.

GENESIS is for project engineers, weapon system designers, system program analysts and anyone who needs to perform "what if" or parametric studies of weapons system effectiveness.



Applications

A typical **GENESIS** application is a sensitivity analysis in which weapon effectiveness is evaluated as a function of an input parameter, such as the probability of detection. Other applications include:

- Operational requirements definition
- Concept development
- System design
- System evaluation
- Operational effectiveness support

While there are several smart weapon many-on-many simulations in the community, **GENESIS** offers a unique capability. Its menu driven interface makes it very easy to learn and to use. Its flexibility allows the model to simulate a wide variety of weapon concepts. These range from unguided bomblets to submunitions with complex processing techniques dispensed from smart delivery systems. The simulation graphics provide the user with an understanding of exactly what is happening in the end game. **GENESIS** also provides the most extensive reporting options of any many-on-many effectiveness models available.

In 1990, **GENESIS** version 1.3 was adopted by the Joint Technical Coordinating Group on Munition Effectiveness (JTCG-ME) as the tri-service standard many-on-many effectiveness model. Version 2.4 is the latest version and has undergone verification and validation by AMSAA, and has been accepted as the standard for effectiveness modeling of indirect fire precision guided munitions.

GENESIS is available to US Government Agencies and their contractors.

Technical inquiries should be directed to Stephen Bramblett, 256.382.4730 or email: wstiac@alionscience.com

GENESIS may be purchased by contacting WSTIAC at
315.339.7047 • Fax: 315.337.9932 or email: wstiac@alionscience.com

calendar of events

Upcoming Conferences and Courses

September 2007

Unmanned Aerial Vehicles (UAV) Conference

12-14 September 2007

Arlington, VA

For additional information:

<http://www.ttcus.com/view-conference.php?id=34>

9th Fleet Maintenance Symposium 2007

18-19 September 2007

Virginia Beach, VA

For additional information:

<http://www.asne-tw.org/asne/fms07/index.html>

Directed Energy Weapons (DEW) Conference

20-21 September 2007

Washington, DC

For additional information:

<http://www.ttcus.com/view-conference.php?id=35>

October 2007

AIAA 5th Biennial National Forum on Weapon System Effectiveness

16-18 October 2007

Huntsville, AL

For additional information:

<http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1803>

10th Annual Systems Engineering Conference

22-25 October 2007

San Diego, CA

For additional information:

<http://www.ndia.org/Template.cfm?Section=8870>

Directed Energy Weapons Course

30-31 October 2007

Huntsville, AL

For additional information:

<http://wstiac.alionscience.com/wstiac/training.do>

November 2007

IMAPS 2007

11-15 November 2007

San Jose, CA

For additional information:

<http://www.imaps.org/imaps2007/index.htm>

Smart/Precision Weapons Course

13-15 November 2007

Huntsville, AL

For additional information:

<http://wstiac.alionscience.com/pdf/SPW2007.pdf>

DoD Maintenance Symposium & Exhibition

13-16 November 2007

Orlando, FL

For additional information:

<http://www.sae.org/events/dod/>

154th Meeting of the Acoustical Society of America

27 November – 01 December 2007

New Orleans, LA

For additional information:

<http://asa.aip.org/meetings.html>

WSTIAC Directory

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DEFENSE TECHNICAL INFORMATION CENTER

Attn: IAC Program Office (DTIC-I)
8725 John J. Kingman Road, Ste 0944
Fort Belvoir, VA 22060-6218
703.767.9120; Fax: 703.767.9119
Email: iac@dtic.mil
URL: <http://iac.dtic.mil/>

The advertisement features a central graphic with two silhouettes of soldiers in combat gear, one on the left and one on the right, set against a warm, orange-hued background. Between the soldiers is a large, stylized yellow number '4'. To the right of the '4' is the text 'YOUR FREE HOURS' in bold, with 'Start Now' underneath. Surrounding the central elements is a list of technical capabilities and services in various fonts and sizes: GPS, Smart Weapons, Miniaturization, Sensors & Seekers, Weaponneering, High Energy Lasers, High-Power Microwaves, Directed Energy Weapons, Environmental Protection, Inertial Navigation Systems, Training, Weapons Experts, Technical Inquiries, and Literature Searches.

GPS
Smart Weapons
Miniaturization
Sensors & Seekers
Weaponneering
High Energy Lasers
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WSTIAC offers up to 4 HOURS FREE of technical support to our customers. Drawing upon our weapon system experts, multiple databases, and vast information repositories, WSTIAC supports today's research for tomorrow's war fighters.

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Put our experts to work for you. Submit your inquiry to <http://wstiac.alionscience.com/experts> or call our Toll Free Inquiry Line: 877-WST-USER (877.978.8737)

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